WISEWOOD ENERGY

WEGSCHEID GASIFIERS & KOHLBACH BOILERS

Biomass Energy Technology Symposium

Roseville, CA

May 1, 2023

Wegscheid Entrenco

KOHLBACH

WEGSCHEID GASIFIERS & KOHLBACH BOILERS

Wegscheid Entrenco

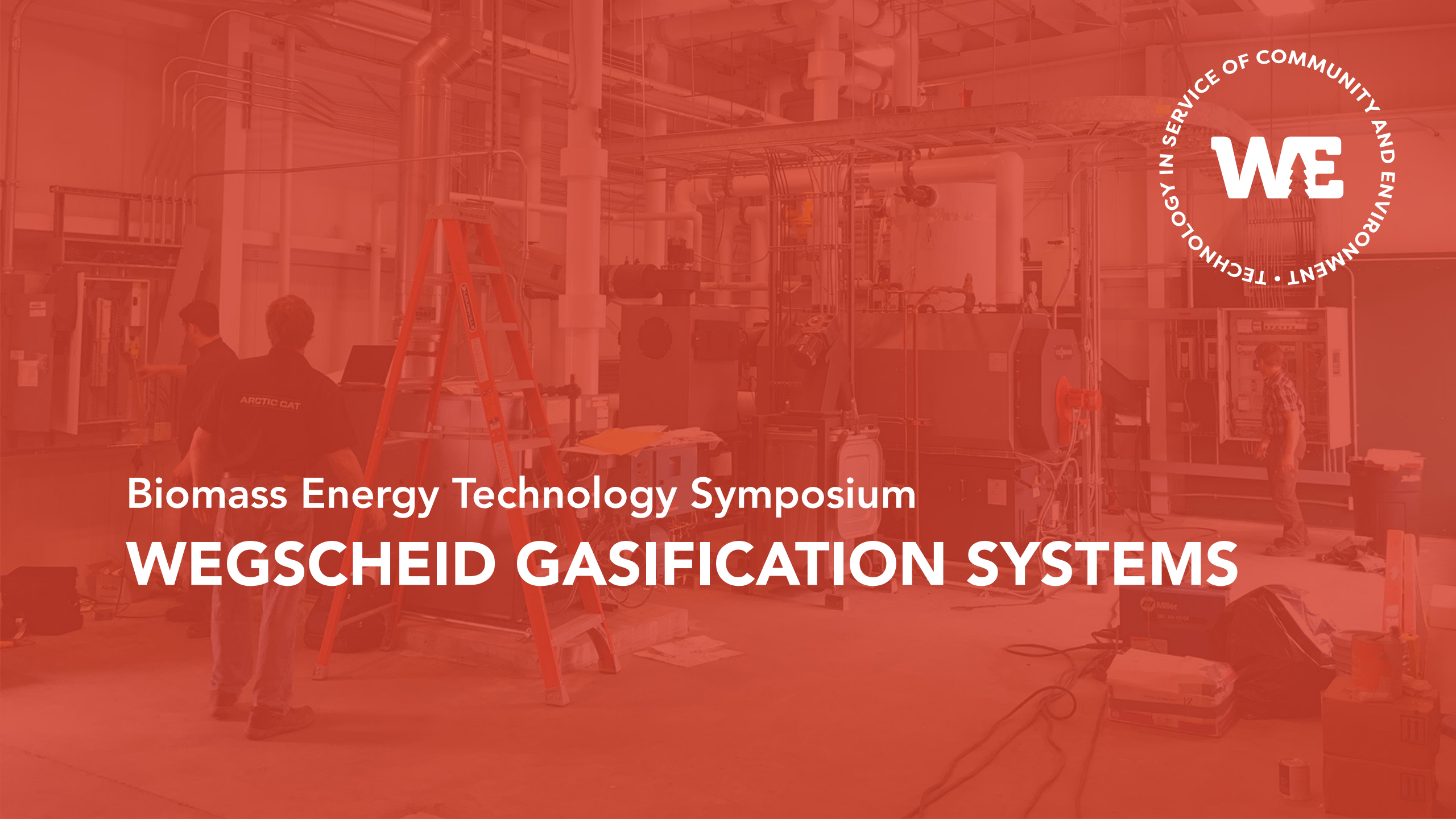
- Modular 125kW gasifier units for CHP applications up to 1MW
- High power efficiency with stable, reliable output
- German company with >130 operating systems worldwide

KOHLBACH

- Wide range of hot water and steam boilers for heat-only or ORC & Steam CHP applications
- Specializes in handling rough/wet fuel
- Austrian company with >3000 operating systems worldwide

WISEWOOD ENERGY

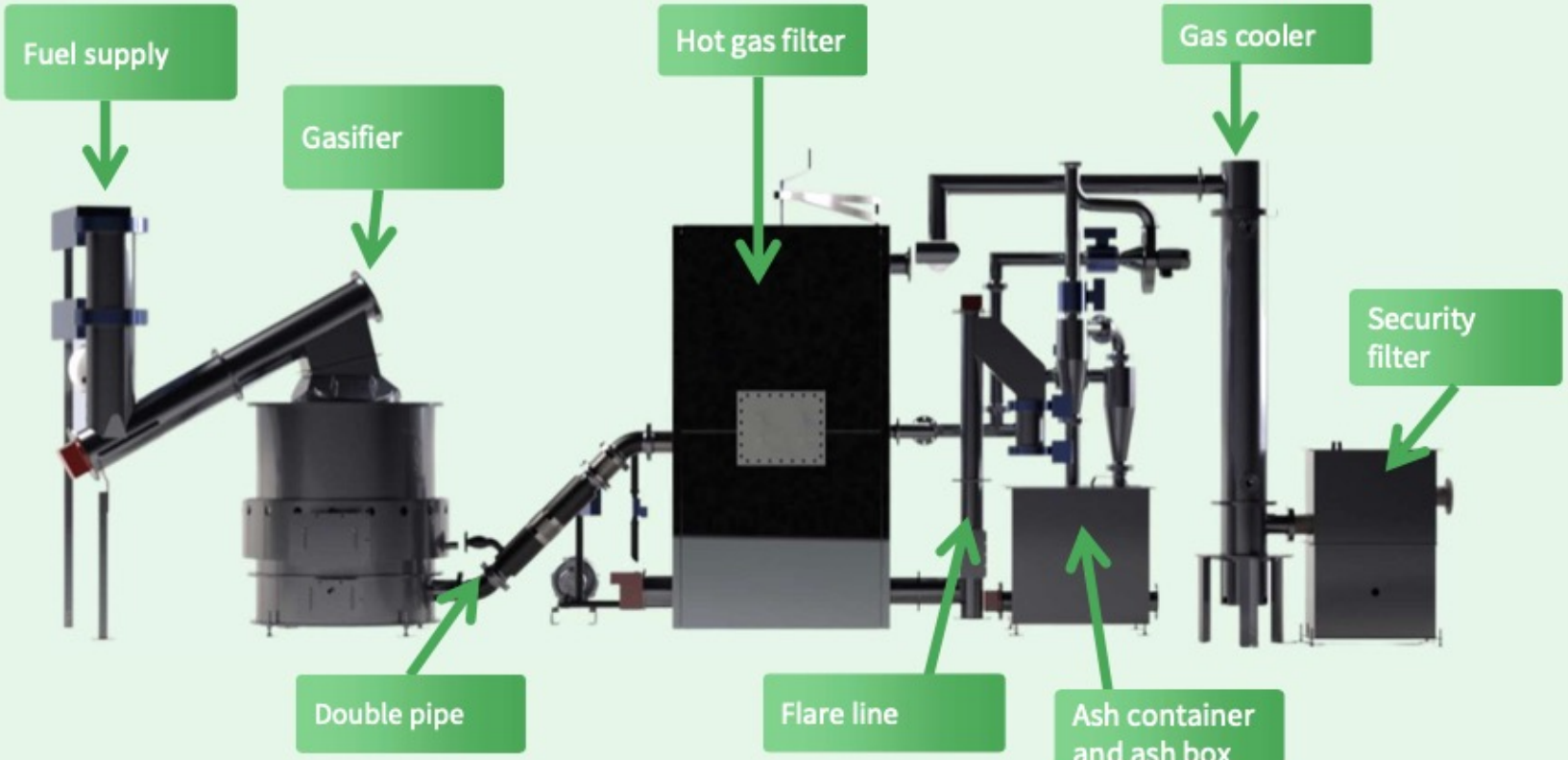
- ✓ Oregon-based EPC firm
- ✓ Tech neutral based on best-in-class options
- ✓ Formal partnership with Kohlbach (KW, Inc)



Biomass Energy Technology Symposium

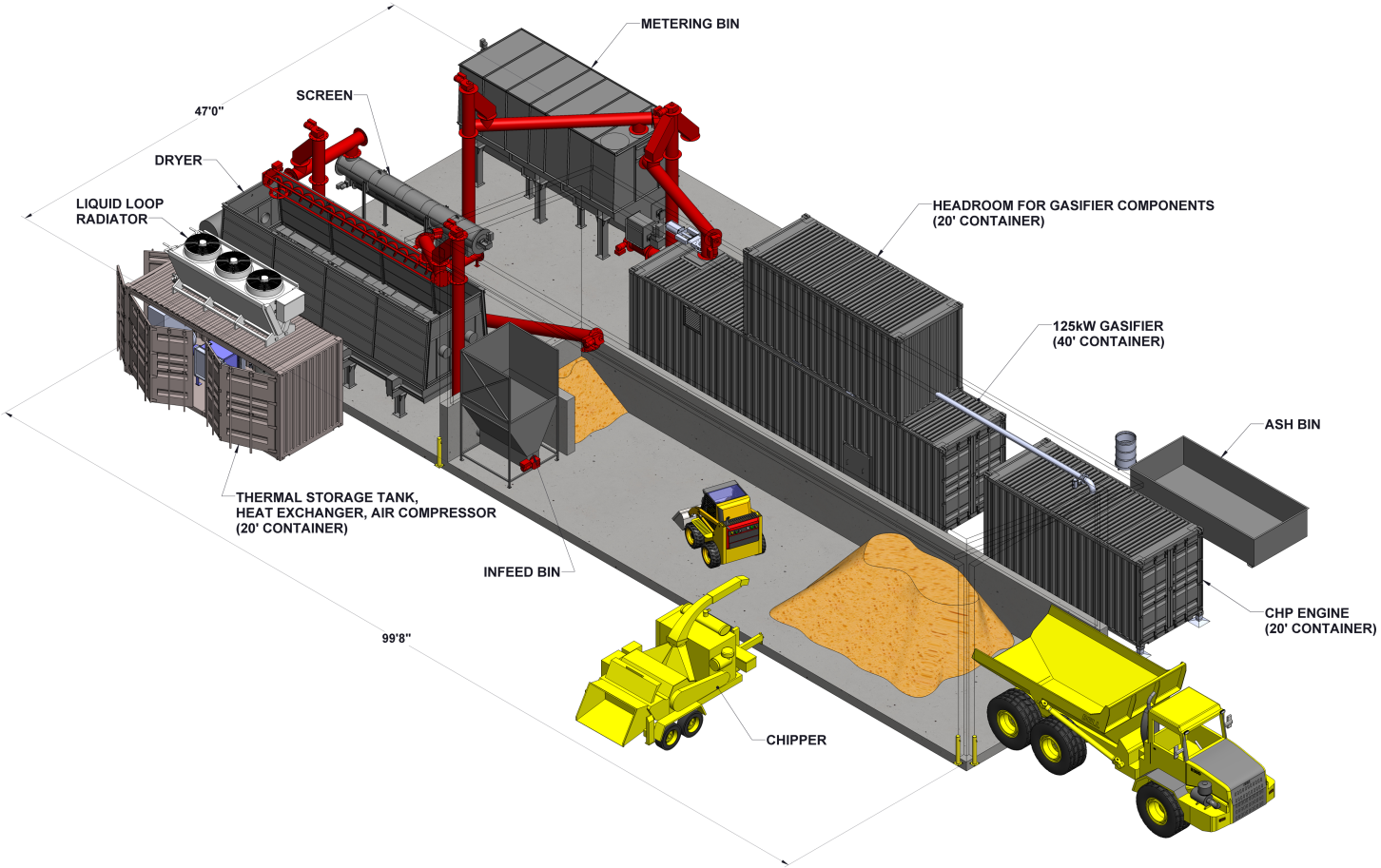
WEGSCHEID GASIFICATION SYSTEMS

125KW GASIFIER PROCESS



125KW – 1MW GASIFIER SYSTEMS

- **Modular**
  - 125kW units can be scaled for higher energy demand
  - Option to containerize for minimal on-site costs
- **Efficient**
  - 30% electrical efficiency is unique
  - >80% when thermal energy is used productively
- **Reliable, Always-On Energy**
  - 24/7 operations, 7500+ hours per year with most operators reporting >8,000 hours uptime
- **Widely Applicable**
  - Net metered systems
  - Critical infrastructure, especially paired with microgrid controls
  - Community energy systems with expansion potential



THE FUEL

Our wood powered generation systems are fed with G50 to G70 wood chips, preferably from softwood or hardwood. Our systems require no other auxiliary fuels.

DRYING

The best energy yield is supplied by wood chips with residual moisture of <10%. We offer our customers two types of dryers:

- 30m³ system with lateral discharge
- Passable drying boxes, also suitable for third-party drying and contract drying

THE SCREENING PLANT

Wood chips must be as homogeneous as possible in terms of their size. Our optional screening plant separates out fines, as these hinder the process. This byproduct can be used to feed a conventional wood chip heating system, or can be sold.

THE STORAGE CONTAINER

Systems from Holzenergie Wegscheid produce power and heat continuously – far more than 8,000 hours a year of continuous operation. Storage containers in the required sizes provide a regular supply.

THE GASIFIER

Designed for environmental protection and utmost reliability. Our gasifier helps us generate virtually tar-free gas, ensuring an absolutely stable and continuous operation of the system.

THE FILTER

The patent-pending filter facilitates dry cleaning of the gas, leaving nothing but ashes, which in turn can be used as fertilizer or sold as a commercial product.

HEAT RECOVERY

Efficiency across the board. The heat recovered from the gas cooling is fed into the heating circuit. Systems from Holzenergie Wegscheid make use of the radiant heat in the gasifier room as intake air for the drying process.

THE CHP PLANT

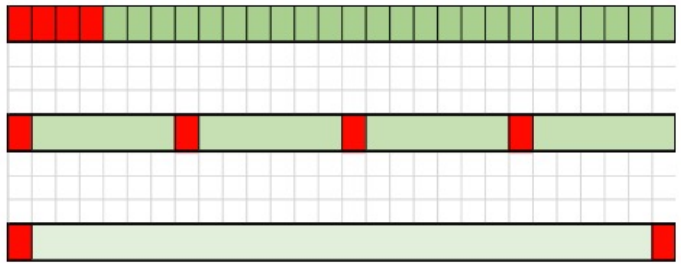
Our systems have a particularly high load capacity in continuous use. The reliable, robust loading, an innovative filter system, and the high-quality brand motor guarantee round-the-clock operation – day after day, month after month, year after year.

EXAMPLES OF FUEL QUALITY

OPERATIONS, CAPEX

Little operation and maintenance while running; major maintenance is performed once a year by a service team.

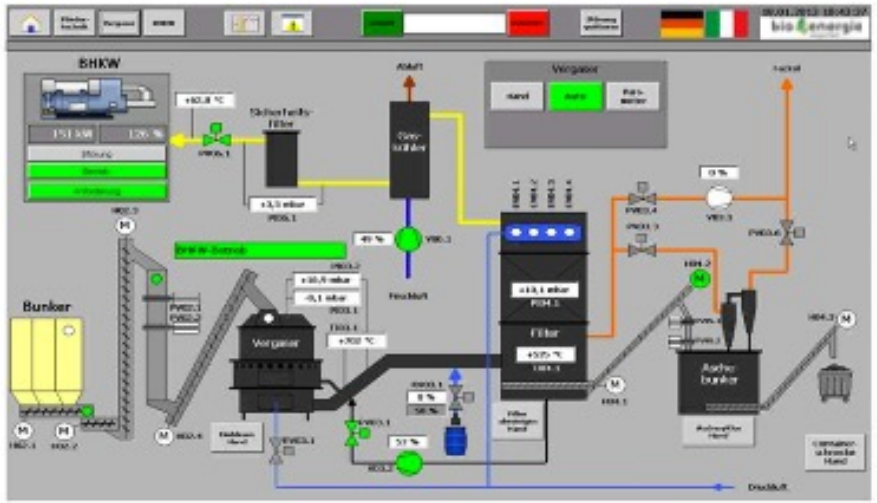
Operating frequencies



Daily:
Visual inspection
Empty condensate trap

Weekly:
Empty ash container

Monthly :
Engine oil change
Cleaning the carburetor



	125 kW	250 kW	500 kW	1 MW
Gasifier Capacity				
Type of wood fuel	Wood Chips, 10% mc			
Number of gasifier units	1	2	4	8
Nominal electricity capacity [kW]	125	250	500	1,000
Nominal heat capacity [kW]	238	476	952	1,904
Est. plant availability [hrs/yr]	8,000			
Energy Generation				
Net electricity production [kWhr/yr]	900,000	1,800,000	3,600,000	7,300,000
Net thermal energy production [MMBtu/yr]	6,000	12,000	24,000	47,000
Fuel Use				
Wood fuel demand [BDT/yr]	700	1,400	2,700	5,500
Operations & CapEx				
Daily O&M	~0.25 FTE	~0.50 FTE	~0.75 FTE	1.2 FTE
Periodic & Annual Preventative Maintenance	~100 hrs/yr	~200 hrs/yr	~400 hrs/yr	~600 hrs/yr
CapEx (major equipment only, including dryer)	Roughly $1.5M per 125kW unit			

EMISSIONS, VIDEO

- Clean systems with very low PM and potential mitigation required for Nox, similar to fossil fuel generators
- Control options include Selective Catalytic Reduction (SCR) for decreased NOx, CO, PM
- Video link

WEGSCHEID-ENTRENCO REFERENCES

More than 130 plants are installed around the world in a wide range of industries. The oldest plant has been in operation since 2009.

Industries

- Municipalities with bath and heating networks
- Hotels and wellness
- Wood processing (drying)
- Food production (cooling by heat)
- Large industry and local trade (process heat)
- Other

- **First facility in US to break ground in 2023**
  - Heartwood Biomass integrated wood yard, Tuolumne County
- **Others in planning stages, including:**
  - South Tahoe Refuse waste transfer site, South Lake Tahoe CA
  - Black Oak Mine Unified School District, Georgetown CA

USE CASE

Even in the case of heating or cooling for own use, the productive runtime of the plants has a direct influence on the economic efficiency.

Refrigeration (IT):

In early 2014, Sampeyre in Italy commissioned a 125 kW + 65 kW plant. The customer, a cooperative of farms, uses the electricity and converts the heat into cold.

Annual operating time: +8,100 Std.

Wood chip drying:

The 125 kWel system installed in 2014 by a Bayreuth-based company with a sawmill and timber trade, which also offers wood chips, uses the electricity for its own supply and the heat for drying wood chips.

Annual operating time: +8,100 Std.

we
WEGSCHEID ENTRENCO

USE CASE

When generating process heat, the reliability of the equipment is particularly important so as not to interrupt the ongoing production process.

Process Heat (DE):

The prototype plant has been in operation in Wegscheid since 2009 and generates 125 kWel. Electricity: The electricity is fed into the utility grid.Heat: District heating to three neighboring companies for process and heating purposes.

Annual operating time: +8,300 hours.

Process Heat (IT):

A manufacturer of glued laminated beams in Mühlbach, South Tyrol, connected a 125 kWel. plant to the grid in October 2013. Special feature: the plant is fired with wood briquettes from a press (wood chips).

Electricity: currently supplies 139 kWel. Heat: drying of wood products.

Annual operating time: +8,600 hours.

we
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ENTRENCO

USE CASE

As a pioneer in the construction of cascaded plants in the 1-2 MW class, WegscheidEntrenco has a very positive performance record. Advantageous: relatively large plants.

Cascading 720 kW (IT):

This plant in Italy is a 6-module plant used in a sawmill for waste utilization and heat generation.

The plant has been in operation since 2014.

Jährliche Betriebszeit: +8,200 Std.

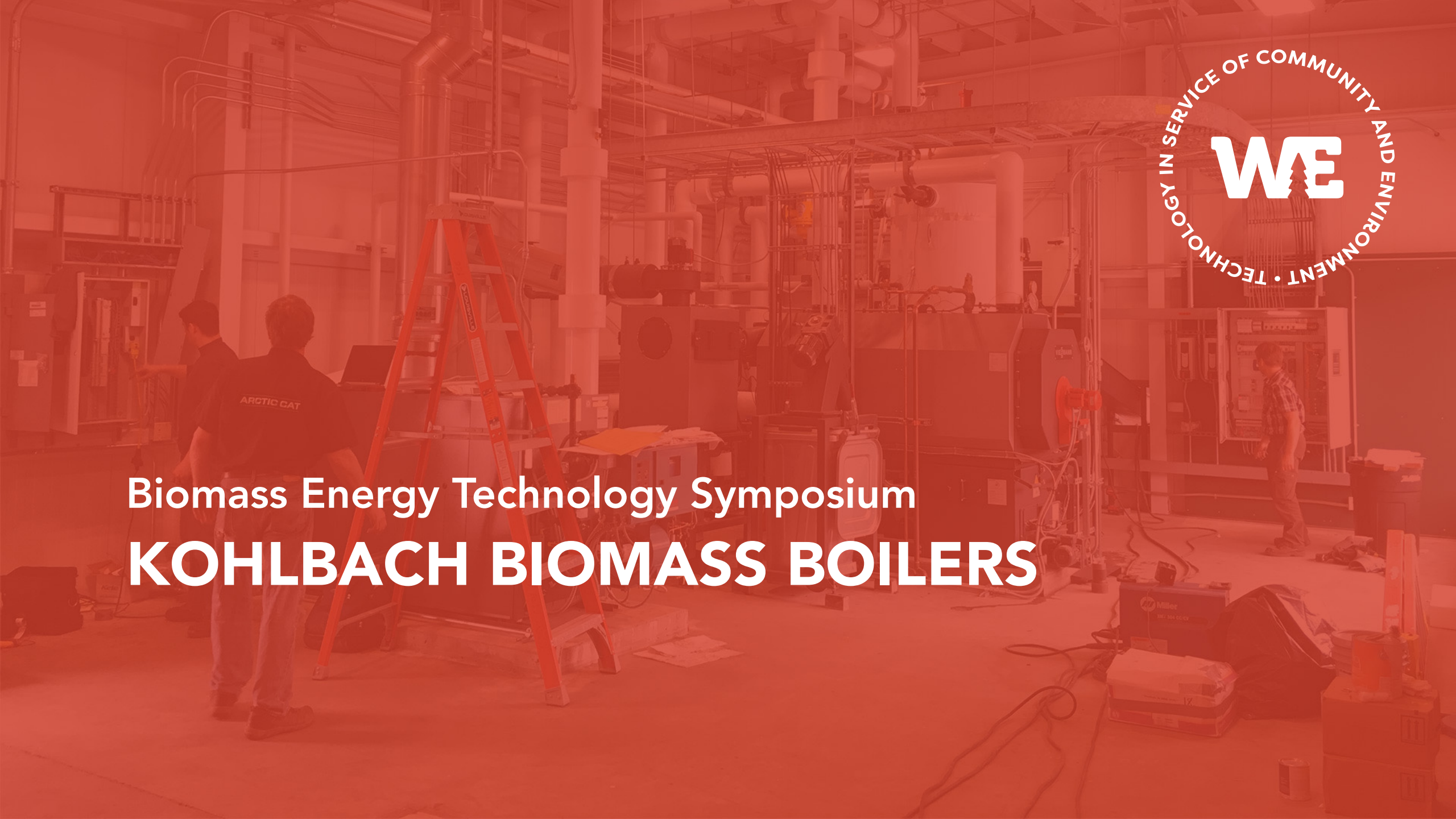
Customized solution 1 MW (UK):

A 1 MW plant is located in Scotland and consists of 8 units of 125 kWel each. This plant was built individually for the customer.

The plant has been in operation since spring 2017.

Annual operating time: +8,100 Std.

we WEGSCHEID ENTRENCO



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KOHLBACH BIOMASS BOILERS

EXPERIENCE, INNOVATION, RELIABILITY

- **60 years of experience**
- **Broad knowledge about energy from wood**
- **3000 systems operating globally**
- **3 systems installed by Wisewood in US**
  - County Health & Human Services Center in Quincy, CA (2016)
  - District Heating for Elementary School, County Building, Sheriff's Office, Mental Health Facility, Church in Burns, OR (2016)
  - 60,000 Wood/Alfalfa Pellet Plant in Hines, OR (2019)
  - Mt. Bachelor Ski Resort in Bend, OR (2023 construction)

WIDE VARIETY OF BIOMASS FUELS



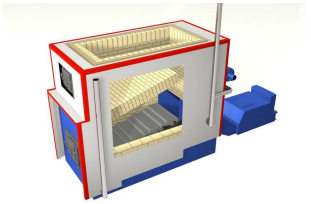


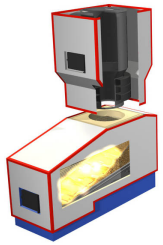
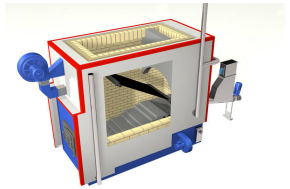
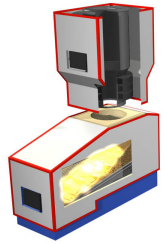



1,360 – 60,000 MBH BOILER SYSTEMS

(400kW – 17MW+ thermal capacities)

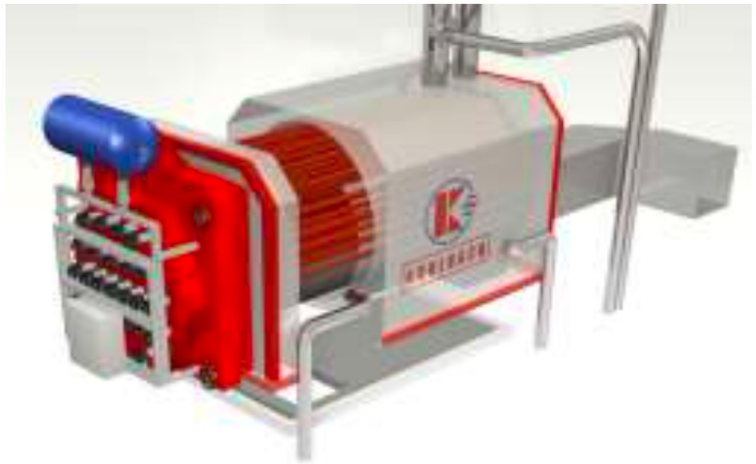
Two-phase combustion system, thermal efficiency >90%



	K8	K11	K12	K13	K16
Capacity (kWth)	400-18,000 Hot Water/Steam	400-18,000 Hot Water/Steam	4,000-18,000 Hot Water/Steam/ Thermal Oil	900-6,800 Hot Water/Steam	4,000-18,000 Hot Water/High Pressure Steam
Feedstock	Wood Chips *can include 100% bark*	Wood Chips/Saw Dust	Wood Chips *can include 100% bark*	Wood Pellets *can include grain residues*	C&D Waste Wood
Fuel Spec	20-60%mc 30-100mm	20-50%mc <50mm	20-60%mc 30-100mm	<10%mc	5-30%mc

WIDE VARIETY OF HEAT MEDIUMS



WARM/HOT WATER BOILER

Boiler‘s nominal output: 400 to 18,000 kW

Output: Warm water up to 110 °C OR hot water up to 200 °C

Variants:

- 3-pass-boilers optimized or full load operation OR 2-pass-boilers optimized for smooth modulating partial load operation
- Horizontal-on-top-of-furnace-design for minimal thermal radiation losses and efficiency optimization OR upon request also in vertical standing design to accommodate special space constraints
- 6 to 16 bar Operating pressure: Every boiler is customized to the particular customer requirement

WIDE VARIETY OF HEAT MEDIUMS

STEAM BOILER

Boiler‘s nominal output: 400 to 18,000 kW

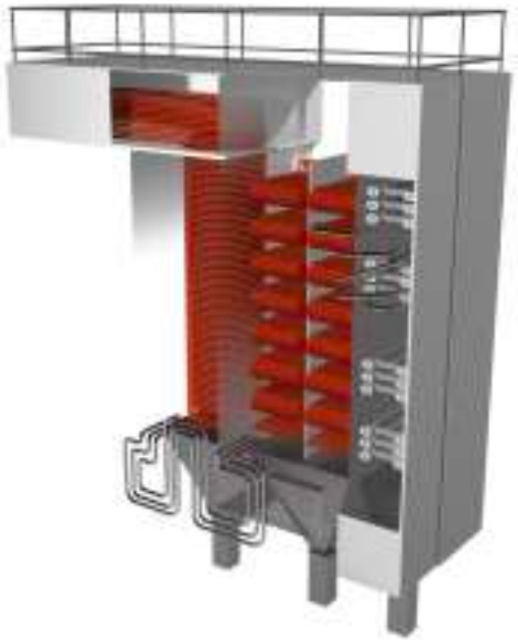
Output:

- Steam up to 450 °C, from 0.5 to 40 bar
- Process steam OR
- For combined Power and Process steam generation with steam turbines or steam engines

Variants:

- Every boiler is custom designed to the particular customer requirement, incl. design approval- and shop testing by notified bodies
- Saturated steam boilers for Process steam OR High pressure steam boilers for Cogeneration

WIDE VARIETY OF HEAT MEDIUMS



THERMAL OIL BOILER

Boiler‘s nominal output: ~1,500 to 18,000 kW

Output:

- Heat and Power with ORC-Turbine OR
- Process heat on high temperature levels (Flow temperature >150 °C to 315 °C)

Variants:

- Optimized for use with ORC-heat and power cogeneration OR for high temperature process heat
- Module sizes adjusted to the standard sized ORC-Modules available on market
- Available as split-up multi-pass-system for easy accessibility and long continuous operating runs also with heterogeneous fuels (bark and green cuttings) OR upon request as price and space saving 3-pass-boiler with tube-coil design use with selected high quality fuels

APPLICATIONS – PROCESS HEATING

Kohlbach biomass boiler plants assure a reliable and efficient supply of heat from 400 to 18,000 kW per module:

- **Warm/hot water boilers**: Warm water up to 110 °C and hot water up to 200 °C
- **Steam boilers**: from 0.5 to 40 bar, hot steam temperatures up to 450 °C
- **Thermal oil boilers**: Process heat at high temperature levels (supply temperatures > 150 °C to 315 °C)

In the process, the heat utilisation is sufficient for churches, environmentally-sensitive tourist locations, workshops, productions halls, as well as the supply of dry or steam chambers, dairies, breweries, hospitals, nurseries, and much more.




APPLICATIONS - COGENERATION

The simultaneous generation of power and heat from biomass is the supreme discipline of biomass utilisation. Therefore, Kohlbach boilers are designed in special capacity ranges attuned to common turbine module sizes:

- **High-pressure steam boilers** for steam turbines and engines: Fire tube boilers up to 40 bar or water tube boilers for higher pressure levels, 6,000 kW or higher
- **Thermal oil boiler plants** for ORC technology (Organic Rankine Cycle): For small combined heat and power plants ranging from 200-2,200 kW electric, low pressure boiler circuit operation, very high overall system efficiency, outstanding partial-load characteristics, tried and tested durable technology




Harney Community Energy

2,327MBH District Heating in Burns, OR

Photo: Marcus Kauffman

Plumas Health & Human Services Center

400kW Heat, 35kW Electricity ORC in Quincy, CA

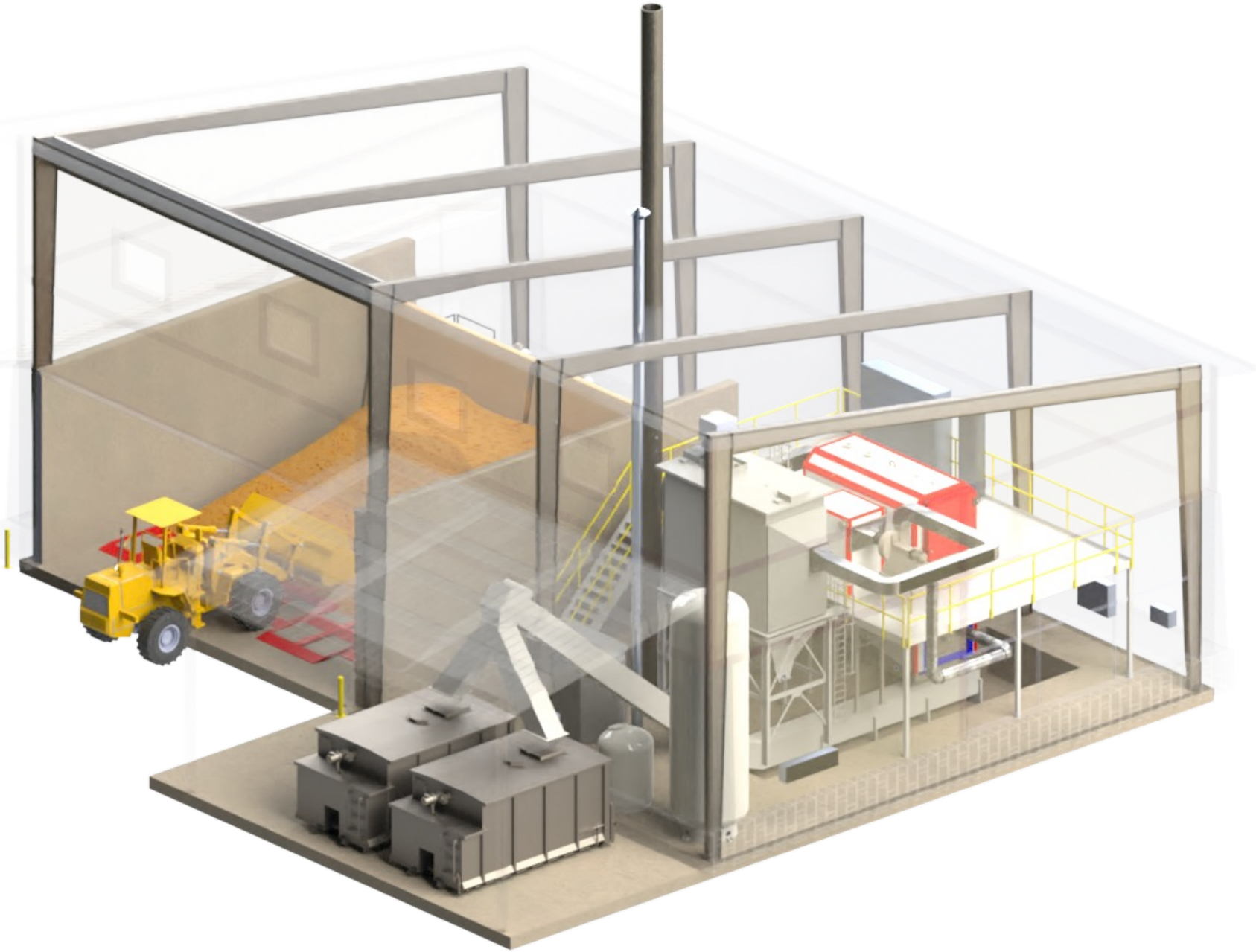
Wood & Alfalfa Pellet Mill in Oregon

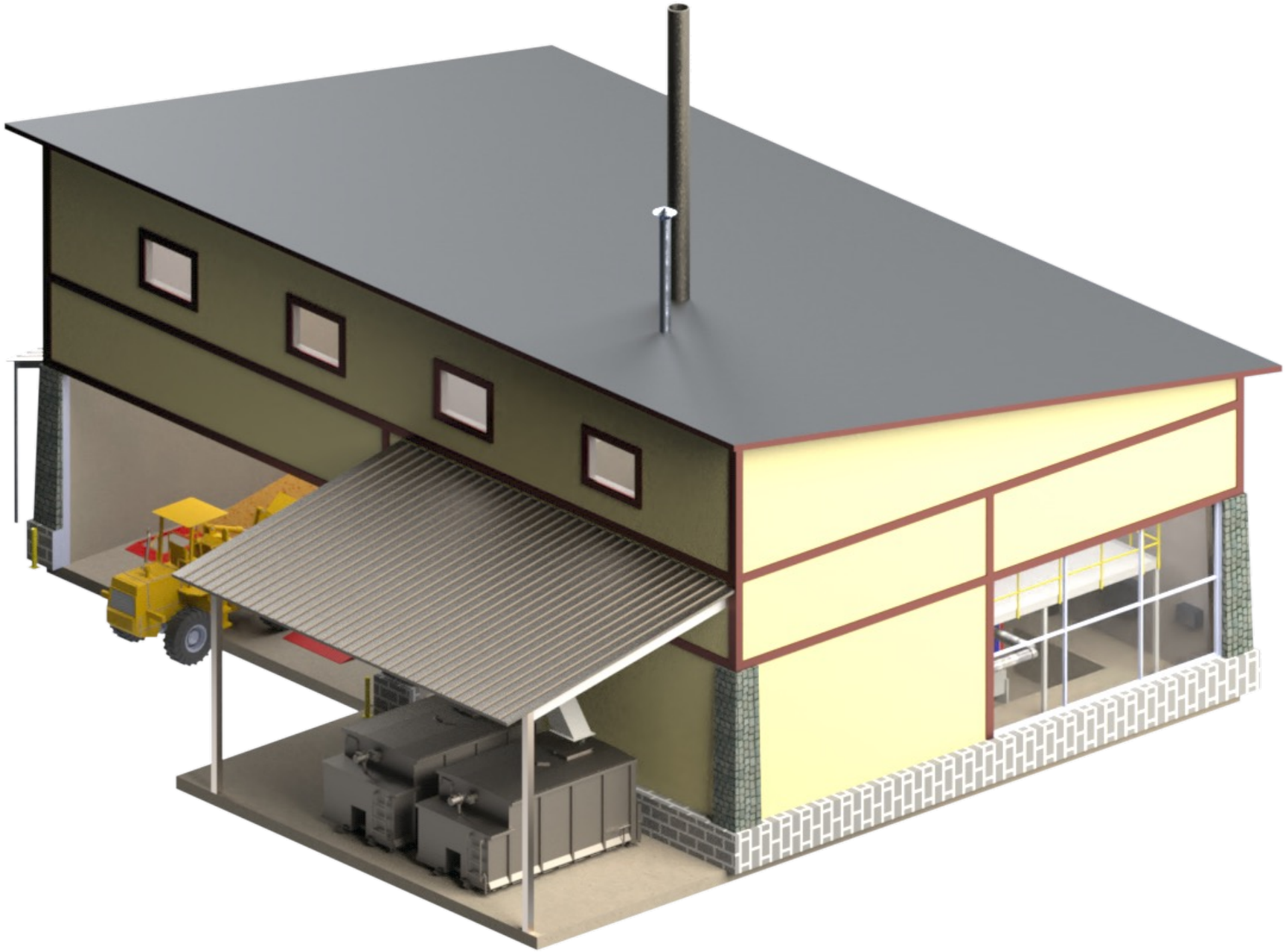
7 MWth Medium Pressure Steam

Mt. Bachelor Ski Resort District Heating

1.2MWth District Heating in Deschutes County, Oregon

TECHNOLOGY IN SERVICE OF COMMUNITY AND ENVIRONMENT





THANK YOU! QUESTIONS?

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